AMHS Concept, Usage, Challenges & Future

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01 Training Objectives

Training Objectives

- Understand AMHS architecture based on ICAO Doc 9880 Part II – G-G Application - ATSMHS
- Apply standards-consistent AMHS in the region
- Challenges and Future

Why AMHS Still Matters

- AMHS is the primary ATS messaging backbone
- AMHS still has long operational lifetimes
- Architecture clarity is critical for AMHS–SWIM transition

AMHS Is Not Email

- Not best-effort delivery
- Responsibility-based routing
- Behaviour defined by standards, not implementation choice

02 AMHS Concept & Usage

Standards Hierarchy

- ITU-T X.400 Message Handling System series
- ICAO Doc 9880 Part II profiles X.400 for ATS
- State and regional AMHS implementations documents

AMHS Standards Context

- **Based on ITU-T X.400 Series Message Handling Systems**
  - X.400 / X.402
  - X.411
  - X.413
  - X.419
  - X.420
- **Profiled and constrained by ICAO Doc 9880**
- **Used exclusively for ATS messaging**

Relevant ITU-T Recommendations

- X.400 / X.402 – Architecture and service overview
- X.411 – Message Transfer System
- X.413 – Message Store
- X.419 – Protocols P1, P3, P7
- X.420 – Interpersonal Messaging (P2)

ITU-T Recommendation X.400 – MHS Overview

- Provides high-level overview of Message Handling Systems
- Introduces MHS concepts, services and terminology
- Conceptual and descriptive – no protocol definitions
- Not sufficient alone to implement AMHS
- Forms conceptual entry point for AMHS standards
- Referenced in ICAO Doc 9880 Part II Chapter 1

ITU-T Recommendation X.402 – Overall MHS Architecture

- Defines the overall architectural model of Message Handling Systems
- Identifies logical entities: UA, MTA, MS
- Defines service boundaries and interactions
- NOT a protocol or message specification
- Provides architectural basis for all AMHS protocols
- Used implicitly throughout ICAO Doc 9880 Part II

ITU-T Recommendation X.411 – MTS Abstract Service

- Defines the abstract service of the Message Transfer System (MTS)
- Describes what the MTS must do, independent of protocol or encoding
- Specifies message, probe and report transfer services
- Establishes the responsibility model for routing and delivery
- NOT a protocol (P1, P3 and P7 are defined in X.419)
- Profiled for ATS use in ICAO Doc 9880 Part II (Chapter 3)

ITU-T Recommendation X.413 – Message Store Abstract Service

- Defines the abstract service provided by the Message Store (MS)
- Specifies storage, retrieval, listing and deletion of messages
- Supports deferred and mailbox-based access
- NOT a protocol – MS access protocol (P7) is defined in X.419
- Used only if a Message Store is implemented
- Referenced in ICAO Doc 9880 Part II Chapter 5

ITU-T Recommendation X.419 – Protocol Specifications

- Defines protocols that realise MHS abstract services
- P1: MTA ↔ MTA (MTS Transfer Protocol)
- P3: UA ↔ MTS (MTS Access Protocol)
- P7: UA ↔ Message Store (MS Access Protocol)
- Does NOT define MTS behaviour or message content
- Normative AMHS protocol reference in ICAO Doc 9880 Part II

ITU-T Recommendation X.420 – Interpersonal Messaging (P2)

- Defines the Interpersonal Messaging (IPM) abstract service
- Specifies structure and semantics of ATS messages (P2)
- Defines envelopes, priorities, identifiers and reports
- Message content only – not a transport or access protocol
- P2 is carried over P3 or P7 and transferred using P1
- Profiled by ICAO Doc 9880 Part II for ATS messaging

Role of ICAO Doc 9880 Part II

- Defines the Aeronautical Message Handling System (AMHS / ATSMHS)
- Normative technical specification for ground–ground ATS messaging
- Profiles and constrains ITU-T X.400 Message Handling System standards
- Covers architecture, behaviour, protocols, and inter-State exchange
- Primary reference for AMHS compliance and interoperability

Scope of ICAO Doc 9880 Part II

- Ground–ground ATS message handling only
- AMHS logical entities: UA, MTA, optional Message Store (MS)
- ATS message routing, responsibility, and reporting
- Interworking with legacy AFTN during transition
- Excludes air–ground applications and generic comm services

Doc 9880 Part II and ITU-T X.400 Series

- **X.400 – MHS system and service overview**
- **X.402 – Overall MHS architectural model**
- **X.411 – Message Transfer System (MTS) abstract service**
- **X.413** – Message Store services
- **X.419 – Protocols: P1 (MTA–MTA), P3 (UA–MTA), P7 (UA–MS)**
- **X.420 – P2 message structure**

Key Principle

- Doc 9880 Part II governs AMHS behaviour
- ITU-T X.400 series documents provides underlying technical definitions

03 AMHS Functional Model

AMHS Functional Model

- User Agent (UA)
- Message Transfer System (MTS)
- Message Store (MS)

User Agent (UA)

- ATS application interface
- Originates and consumes ATS messages
- No routing responsibility

UA in AMHS Context

- ATS automation systems
- Deterministic addressing
- Not a human mail client

Message Transfer Agent (MTA)

- Core routing entity
- Implements Message Transfer System
- Exchanges messages with peer MTAs

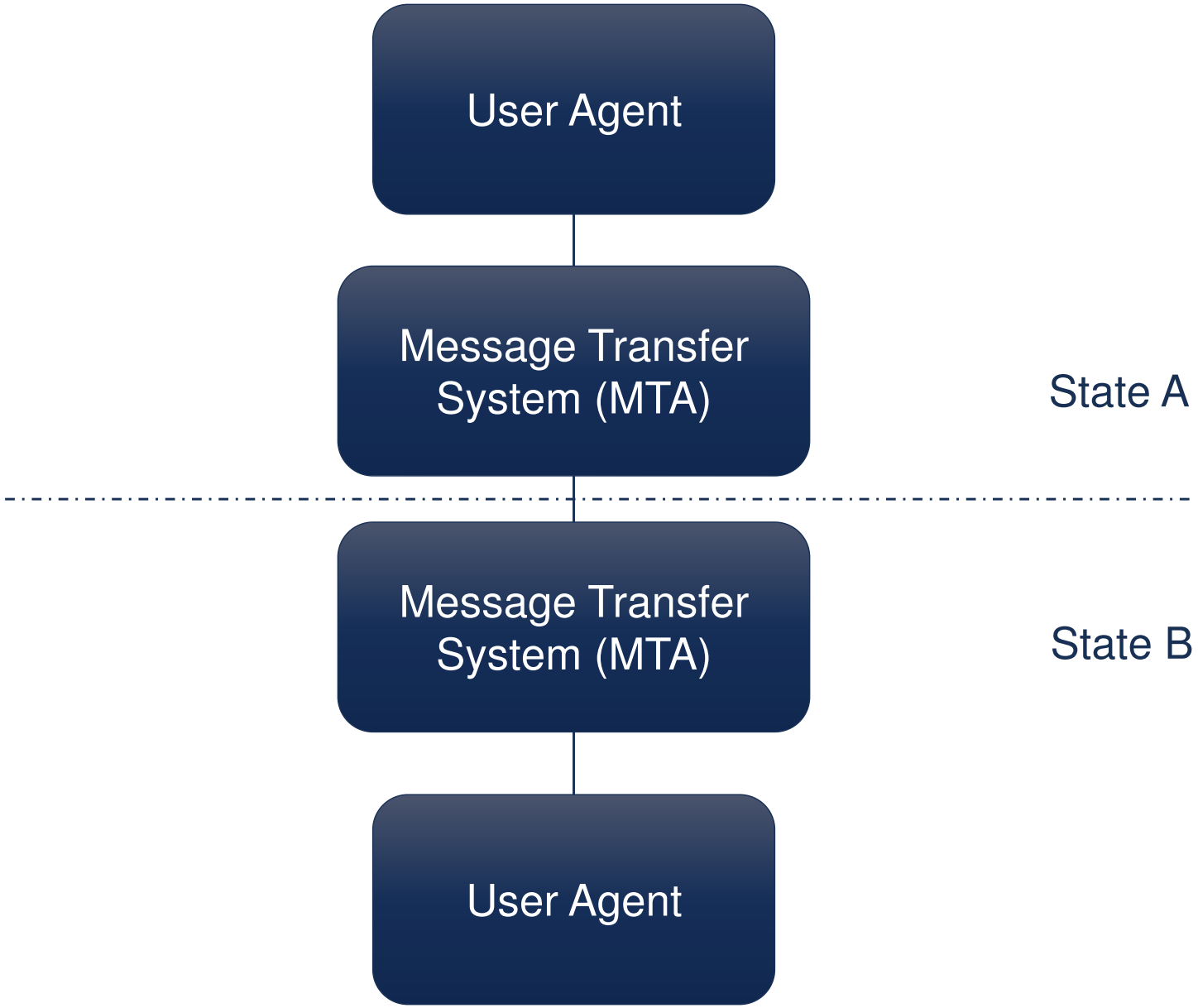
MTA Responsibilities

- Routing and relaying
- Delivery and non-delivery reports
- Responsibility management

Message Transfer System (MTS)

- Logical collection of MTAs
- Provides message transfer services

Architecture: UA – MTA – MTA – UA



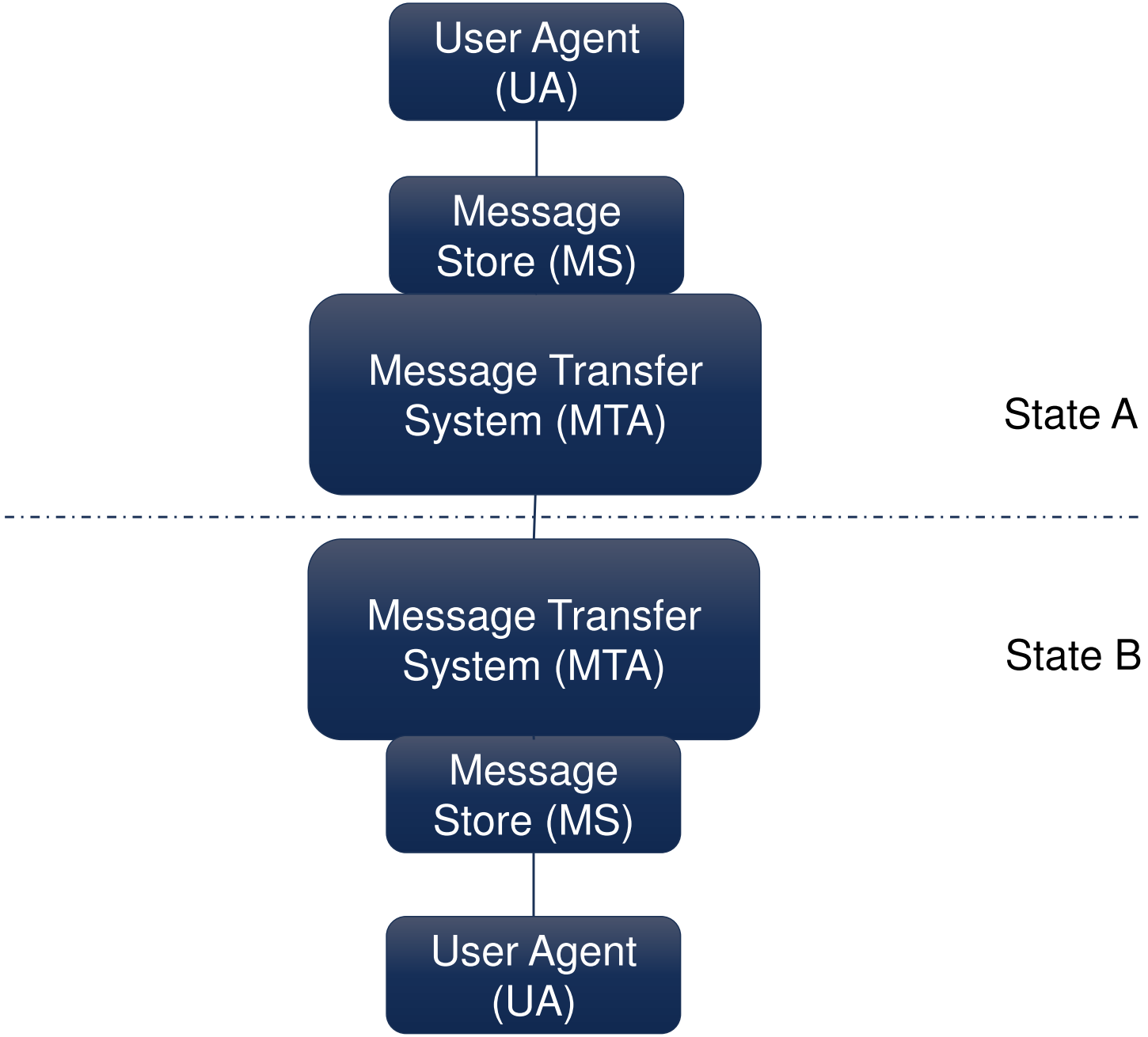
Message Store (MS)

- Optional AMHS functional entity
- Stores messages for later retrieval

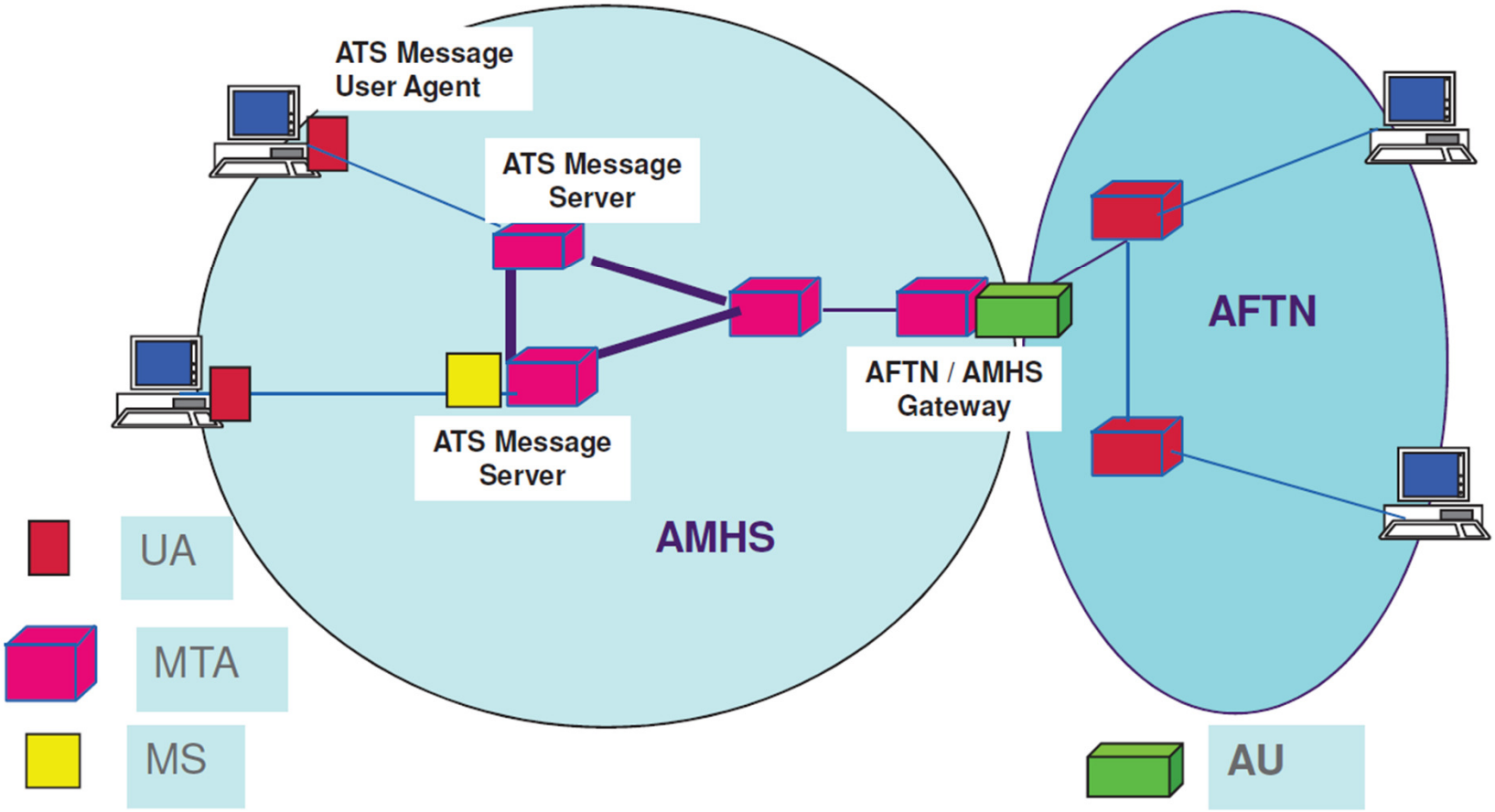
Why MS Exists?

- Deferred user access
- Terminal-style operations
- Operational resilience

Architecture: UA – MS – MTA – MTA – MS – UA



Architecture



Source: ICAO Regional Workshop on AMHS, Dakar, 28-29 May 2013

04 AMHS Protocol Set

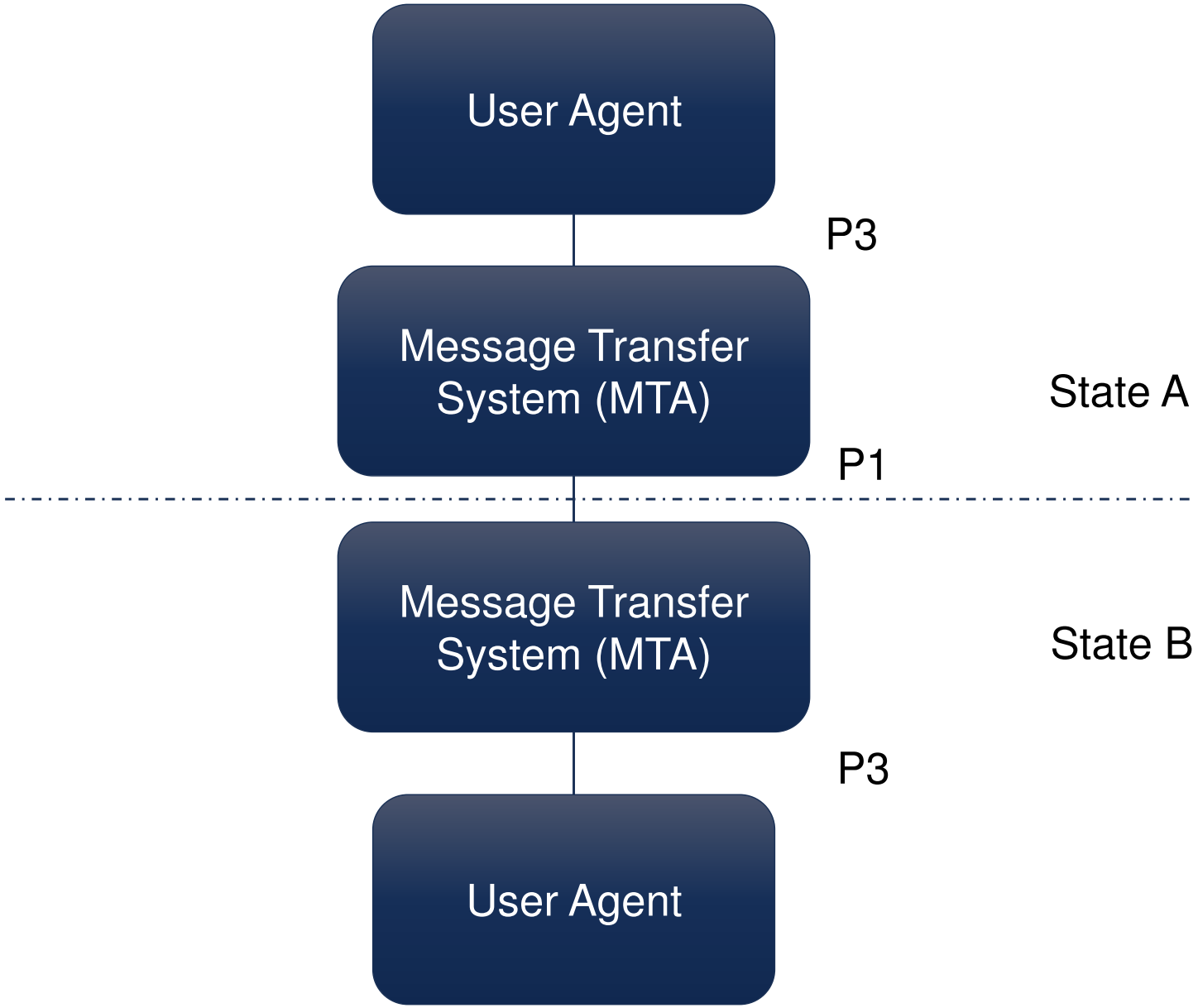
AMHS Protocol Set

- P1 – MTA to MTA
- P3 – UA to MTS
- P7 – UA to MS
- P2 – ATS message content

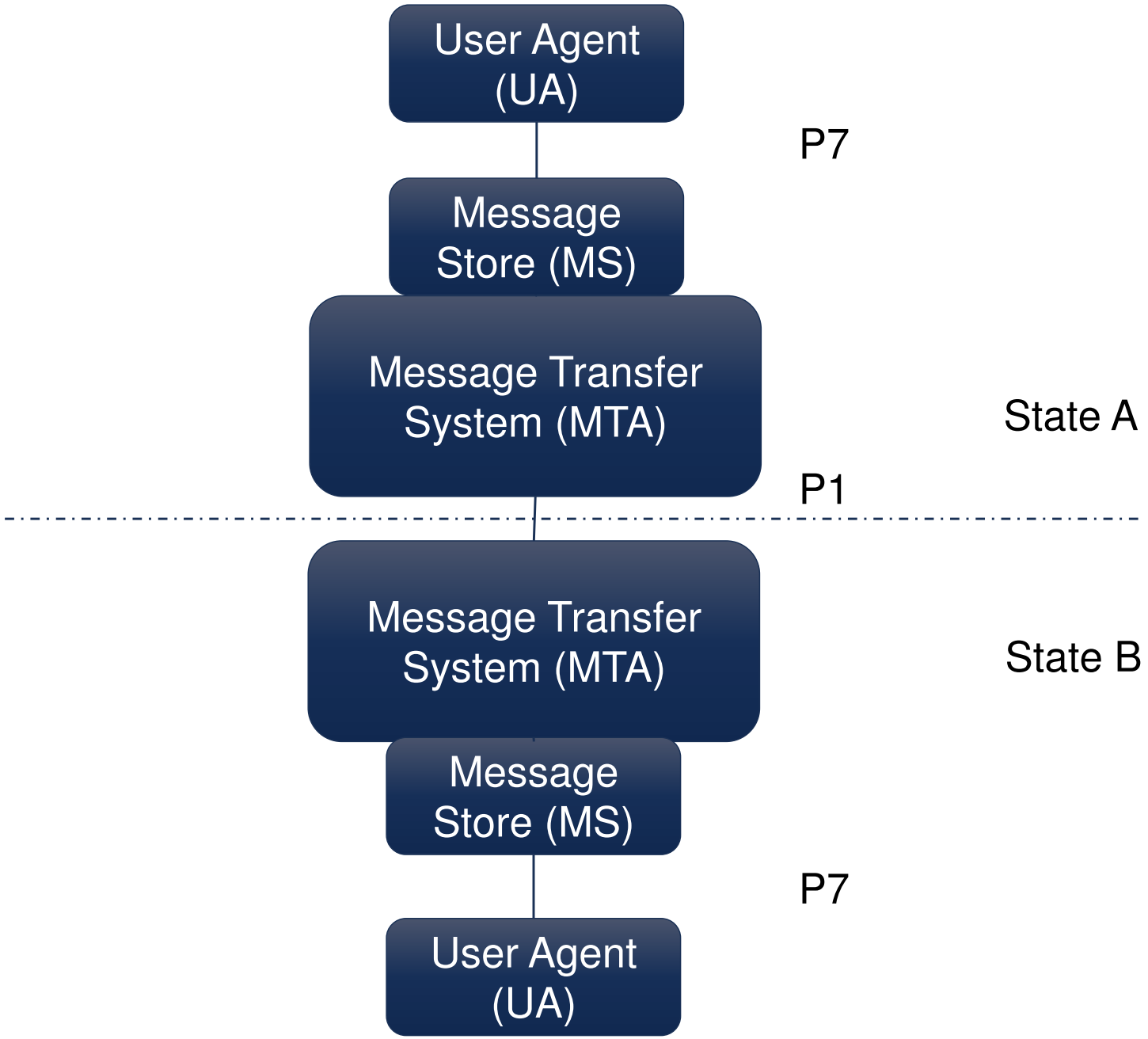
Where are protocols defined?

- X.419 – P1, P3, P7
- X.420 – P2

Protocol Layering



Protocol Layering



P1 Message Transfer Protocol

- Protocol between MTAs
- Enables distributed Message Transfer System

P1 Functional Scope

- Message transfer
- Probe transfer
- Report transfer

P1 Is Mandatory

- All AMHS implementations use P1
- No AMHS without P1
- Routing responsibility
- Generation of non-delivery reports
- Underlying protocol for international ATS exchange

P3 MTA Access Protocol

- Access protocol between UA and MTA
- UA–MTA access without storage
- No Message Store involved

When P3 Is Used

- Real-time submission
- Direct delivery

P7 MS Access Protocol

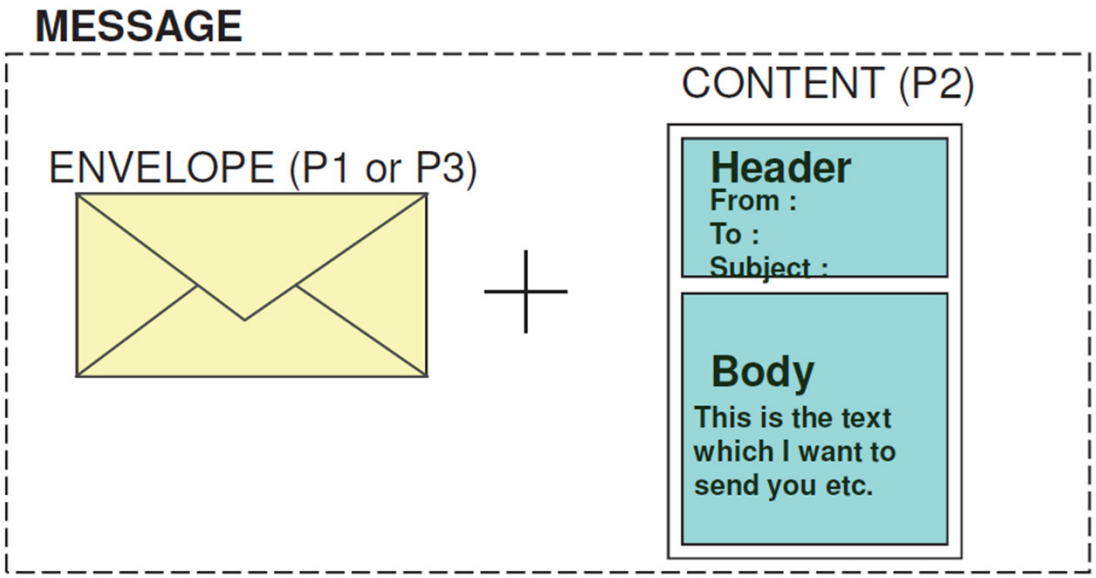
- Access protocol between UA and Message Store
- UA–MS access protocol
- P7 depends on X.413 Message Store

P7 Services

- List messages
- Fetch messages
- Delete messages
- Register operations

P2: Interpersonal Messaging

- Defines ATS message content
- Not a transport protocol
- Not a connection protocol
- Not an access protocol



Source: ICAO Regional Workshop on AMHS, Dakar, 28-29 May 2013

P2 Usage

- Used over P3 or P7
- Independent of Message Store

05 Challenges and Future

Challenges – Technical Limitations

- **Legacy Architecture Limitations**

AMHS relies on X.400-based messaging designed for small, text-centric data, limiting modern flexibility.

- **Handling Complex Data**

Rising use of XML and large structured payloads strains AMHS originally built for simpler messages.

- **Interoperability Challenges**

Local adaptations improve performance but reduce standardisation, complicating global interoperability.

- **Integration Complexity**

Connecting AMHS with modern IP and service-oriented systems requires gateways, adding system complexity.

Challenges – Operational and Regional Reality

- **Implementation Diversity**

AMHS deployment varies across regions with differing functionality, resilience, and automation levels, creating operational challenges.

- **Legacy and Hybrid Systems**

AMHS often operates alongside legacy AFTN or hybrid solutions, requiring careful management of mixed operational environments.

- **Interoperability Issues**

Variations in ICAO profile implementation cause subtle interoperability problems even among compliant systems.

- **Coordination Complexity**

Bilateral and multilateral agreements support the AMHS network but scaling complexities rise with more interconnected systems and diverse regions.

Future of AMHS

- **AMHS Continued Role**

AMHS will remain a critical messaging layer supporting operational aeronautical communications in the near to medium term.

- **Shift Towards SWIM Services**

There will be a gradual move to SWIM-enabled services for richer, timely, and flexible data exchanges in aviation communications.

- **Coexistence and Coordination**

Message-based and service-based systems will coexist regionally, requiring effective coordination for interoperability and safety.

- **Managed Mixed-Mode Environment**

Future aviation communication depends on collaborative planning; operating an AMHS and SWIM mixed-mode environment without compromising safety standards.

Discussion

- Questions
- Regional observations
- Next steps

06 Thank you